

NUTRITIVE ASSESSMENT OF MILK FROM FULANI HERDS IN THE DERIVED SAVANNA ZONE OF NIGERIA

J.A.Akinlade¹, J.A.Alalade², M.K. Adewunmi³, K.A.Adaramola² and H.M Tairu²

¹*Department of Animal Production and Health, Ladoke Akintola University of Technology, P.M.B. 4000, Ogbomoso, Oyo State. Nigeria.*

²*Department of Animal Production Technology, Oyo State College of Agriculture, P.M.B. 10, Igbo Ora, Oyo State.*

³*Department of Animal Science, University of Ibadan, Ibadan, Oyo state.*

ABSTRACT

The quality assessment of fresh cow milk collected from Fulani herds in Ogbomoso, Arolu, Ife-Odan, Oyo and Iseyin in the derived Savanna Zone of Nigeria were carried out in a Completely randomized design with emphasis on the nutrient composition and microbial loads. Four fresh cow milk samples from separate settlements (rugas) were from Ogbomoso, Arolu, Ife-Odan, Oyo and Iseyin and preserved for seven days with 0.01cm Potassium permanganate and kept in the refrigerator at 4°C before laboratory

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analyses. The moisture content of fresh cow milk from different locations ranged between 87.46-88.62%, the crude protein 3.26-3.85%, ash 0.65-0.75%, crude fat 3.49-3.55%, Lactose 0.46-0.64% and solid-non-fat 8.3-9.7%. Mineral composition of the milk showed that potassium content from different locations ranged between 0.46-0.64 percent, Calcium 0.21-0.23%, Magnesium 0.16-0.19%, Zinc 2.34-2.83%, Iron 0.32-0.56%, Copper 1.31-1.61%, Selenium 0.04-0.06%, Lead 0.00-0.14% and Cobalt 0.10-0.26%. Samples of fresh cow milk collected from Ogbomoso, Arolu and Ife-Odan had no traces of Salmonella and *E. Coli* and thus contained low level of microbial count. Therefore, it can be concluded from this Study that with the exceptions of the microbial counts, and lead contents there were no differences in all other parameters considered among the various locations in the zone.

Key words: microbial load, locations, milk, nutrients, composition.

INTRODUCTION

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54 Protein of animal origin as constituted in meat, milk, cheese and egg provides concentrated
55
56 sources of amino acid in suitable proportion for human needs. FAO (1998), reported that an
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58 average human being requires a minimum of 7.5g of animal protein per kilogram body
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60 weight daily to stay healthy. However, an average Nigerian consumes only 3.5g per kilogram
61
62 body weight daily (FAO, 1998). Milk is defined as white liquid produced by female of
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64 the warmblooded animals essentially for the feeding of their young ones (Oyewole, et al.
65
66 , 1997).
67
68 Milk is very important in human diet and act as a good source of protein for body growth, tissue
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70 repair and other vital functions. Milk and its products are component of human food as they
71
72 constitute about one-sixth of all the food eaten by man. It is often described as nature's most
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74 perfect single food for newborn mammals and an important food supplement for adult
75
76 (Apelegan, 2012).
77
78 Cow milk is rich in calcium and potassium mineral elements (Chamberlin, 1989). Milk fats are
79
80 useful in the production of butter and cheese (Akinlade, 2009). Cow milk is also a good source
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82 of protein and vitamins most especially thiamine, riboflavin and cyanocobalamin which are of
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84 practical importance in human diet (Beck et al, 2003).

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86 The cattle owned by the fulanis constitute the majority (estimated 60%) of the national herd (Rim, 1992),
87 and
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89 In Nigeria, milk production is almost entirely from range cattle owned by Fulani pastoralists
90
91 (Alemede and Sadiq, 2008a). Milk production from Fulani cattle have been reported as the
92
93 traditional source of milk for human consumption in Nigeria (Ibeawuche, et al., 2003)
94
95 This study is therefore designed to investigate the nutritional quality of milk
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97 of indigenous cow traditional managed by Fulani herdsman in the derived savanna zone of
98
99 Nigeria. White Fulani cattle also being referred to as Bunaji is the predominant breed of cattle kept
100
101 the Fulani in Nigeria. The colour ranges from white to ash with no other colour markings, the
102
103 average weight is 250-300kg, though predominantly kept in the northern parts of the country,
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105 its rearing has spread to the southern and eastern parts of the country.
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113 MATERIALS AND METHODS

114 115 *Description of the Study Environment*

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Milk samples were collected at Ogbomoso, Arolu, Ife-Odan, Oyo and Iseyin which are located in the derived savanna zone of Nigeria.

Materials/ Sample Collection

An average of 200ml of cow milk each was collected from each Fulani household settlement popularly called 'ruga' and 4'rugas' samples wereconsidered per location in a completely randomized design covering five different locations;Ogbomoso, Arolu, Ife-Odan, Oyo and Iseyin.Milk sample was collected from total milk collected from each site (4 mixed samples were collected from each 'rugas'). Reagents ($0.01cm^3$ Potassium Permanganate) wereused to preserve the samples for seven days in the refrigerator before they were taken to thelaboratory for analysis. The Potassium Permanganate used prevented alteration in thechemical and mineral composition of the fresh cow milk as well as changes that could occur incolour, texture and bacterial growth of the milk samples.

Chemical Analysis:

The proximate compositions were analyzed according to the recommended methods of

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147 A.O.A.C., (1985). The mineral concentrations were determined using a Kemtech Analytical
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149 Alpha-4 Model atomic absorption spectrophotometer for Ca, Fe, Mg, Zn and Cu while flame
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151 emission spectrophotometer (Kemtech Analytical Alpha-4 model) was used to determine K
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153 using appropriate instrumental conditions for each element. Phosphorus was determined using a
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155 UNICAMUV-1 Model visible spectrophotometer

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158 *Description of Enteric Bacteria on Selective Media*
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160 Quantitative analysis for the description and isolation of enteric microorganism was done by
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162 plating the serially diluted milk samples on selective media. MacConkey agar (LOT no.
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164 0000112122) was used to isolate Gram negative lactose fermenting (coliforms) and non-
165
166 fermenting microorganism. The media contains crystal violet dye and bile salts which inhibit
167
168 Gram positive bacteria. Lactose fermenting (pink) isolates on MacConkey agar was sub-
169
170 cultured, gram stained, and confirmed on eosin methylene blue (EMB) agar (LOT no.
171
172 0000129529). Lactose fermenters such as *Escherichia coli* and *Enterobacter aerogenes* can be
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174 differentiated on this media on the basis of size and the presence of a green metallic sheen
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176 (**Atlas et al**, 1995). *E. coli* colonies in this medium are small and have a metallic sheen, whereas
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178 *E.aerogenes* colonies usually lack the sheen and are larger (Chatterjee *et al.*, 2006). The lactose
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180 non-fermenting Gram-negative non-coliform (colorless) isolates were also sub-cultured and
181
182 confirmed on selective media. Salmonella shigella (SS) agar (LOT no. 0000125020) was used
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184 for the isolation of salmonella and shigella sp. Representative salmonella colonies with typical
185
186 black appearance were carried out using supplied indole motility (SIM) medium (LOT no.
187
188 0000133572).

192 *Statistical Analysis*

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194 Data obtained were subjected to analysis of variance using General linear model of SAS,
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196 2000. The significant means were separated using Duncan multiple range test (Duncan 1995).

199 **RESULTS**

201 *Proximate composition*

203 Table 1 shows the proximate composition of fresh milk samples collected from
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205 different locations (Ogbomoso, Arolu, Ife odan, Oyo and Iseyin zone). There were significant
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207 ($P < 0.05$) effect of location on proximate composition of the milk. The moisture contents
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209 did not show any difference among the locations, though the values obtained from Iseyin and
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211 Arolu were higher (87.46-88.62%). The crude protein contents in the fresh cow milk samples
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213 ranged from 3.26-3.85%.
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215 Higher crude protein contents of 3.85, 3.65 and 3.56% were recorded for Oyo, Ogbomoso and
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217 arolu areas respectively. While the least value of 3.26% was recorded for Iseyin location.
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219 The ash content which is reflection of the mineral contents of the milk samples showed
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221 Significant($P < 0.05$) differences and it ranged from 0.65 – 0.75%. The higher values were
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223 recorded for samples collected from Oyo, Arolu and Ogbomoso (0.75, 0.73 and 0.71%) respectively.
224 The value recorded was significantly lower than the value of (4-13%) reported by Ajai *et al.*, (2012) also
225 similarly lower than the value (0.78%) reported by **Tona *et al.*, 2013.**
226
227 The crude fat contents of the milk sample collected from different locations (Ogbomoso,
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229 Arolu, Ife odan, Oyo and Iseyin) showed no significant ($P > 0.05$) difference. Lactose were
230
231 5.82, 5.88, 5.91 and 4.73 for Ogbomoso, Arolu, Ife Odan, Oyo and Iseyin respectively.
232
233 The value of solid nonfat (SNF%) of raw cow milk collected from different locations
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235 of Ogbomoso, Arolu, Ife odan, Oyo and Iseyin ranged from (8.30-9.70%) and for total solid
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237 fat from (11.53-13.11%).
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Mineral composition

The results of mineral compositions of raw cow milk in different locations (Ogbomoso, Arolu, Ife Odan, Oyo and Iseyin) in derived savanna zone of Nigeria are presented in Table 2. The potassium (K) concentration for all the milk samples collected from different locations ranged between 0.46 to 0.64%. The potassium content of milk collected from Oyo, Arolu and Ogbomoso (0.64, 0.63 and 0.62%) were significantly higher in value than that value recorded for Iseyin and Ife-Odan (0.49 and 0.46%). There were no significant ($P > 0.05$) difference in both calcium (%Ca) and phosphorus (% P) content. The value of Ca ranged from 0.21 to 0.23% and P from 0.21 to 0.22%. The milk collected from different locations of Ogbomoso, Arolu, Ife Odan, Oyo and Iseyin had good quality of Ca and P contents. The Magnesium content of raw cow milk collected from different locations ranged between 0.16 to 0.19%. Higher value of Mg contents were observed from milk samples collected from Ogbomoso, Arolu and Oyo (0.17, 0.18 and 0.19%). The trace mineral content in the studies milk samples compared favorably with those reported by other workers. The value of Zn ranged from 2.34 to 2.83% and Fe from 0.32 to 0.56%. The milk sample collected from Ogbomoso, Arolu and Oyo had the higher values for Zn and Fe. The concentration of copper (Cu) in the milk sample collected from Ogbomoso, Arolu, Ife Odan, Oyo and Iseyin were 1.53, 1.56, 1.36,

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272 1.61 and 1.31% respectively.
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274 The milk sample collected from Oyo, Arolu and Ogbomoso had the higher levels for Cu and
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276 the least concentration for Cu were found in the milk sample collected from Iseyin and
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278 Ifeodan. Selenium (Se) content of raw milk collected from different locations
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280 (Ogbomoso, Arolu, Ifeodan, Oyo and Iseyin zone ranged between 0.04 to 0.06%. Higher
281
282 significantly value of Se content were observed from milk sample collected from Oyo,
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284 Ogbomoso and Arolu 0.06, 0.05 and 0.05%. The lower values were observed for milk collected
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286 from Iseyin and Ife odan.
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288 The trace mineral content in the studied milk samples compared favourably with those
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290 reported by others workers. The value of Pb ranged from 0.00-0.14% and Co from 0.10 –
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292 0.26%.
293
294 The milk samples collected from Iseyin and Oyo locations had highest Co and Pb contents
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296
297 *Bacterial Count*
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299 Effect of locations on the bacterial counts of fresh cow milk in derived savanna zone
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301 is presented in Table 3. The samples of fresh cow milk collected from Ogbomoso, Arolu and

302
303 lfe-Odan had no traces of *Salmonella* and *E coli* but lower values when compared with
304
305 microbial count from Ogbomoso (1.21×10^3), Arolu (1.02×10^3) and lfe-Odan (1.09×10^3). Milk
306
307 collected from Oyo and Iseyin were highly contaminated with heavy microbial count, of
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309 *Salmonella* and *EColi*, respectively.
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311

312 Discussion

313
314 The values recorded for moisture content for fresh cow milk from different locations fell within
315
316 the value of 88.27% reported by Alemede and Sodiq (2008).
317

318 The crude protein content recorded for milk samples collected at different locations were higher
319
320 than that value (3.61%) reported by Tona et al., 2013. Higher ash content was observed for cow
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322 milk samples collected from Oyo Arolu and Ogbomoso (0.75, 0.73 and 0.71%). This could be
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324 due to the provision of salt lick after grazing in the zones. The value recorded

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326 was significantly lower than the value (4-13%) reported by Ajai et al., (2012) also lower than

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328 the value (0.78%) reported by Tona et al., 2013. The fat contents of the entire milk sample

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330 were lower than the values (27.55-34.59%) reported by Ajai et al., 2012. Also lower than the

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332 values (4.02%) reported by Tona et al., 2013. Fat is widely known as a source of energy but

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334 excess fat contents in food constitute health risk (Henry, 2003) for this reason, the milk
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336 sample collected from different location was safer for consumption. The values recorded for
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338 lactose was higher than (5.00%) reported by Enbet *et al.*, (2009). The milk samples collected
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340 from Ogbomoso, Arolu and Oyo had higher value than their counterpart for solid nonfat. The
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342 total solid fat was higher for Iseyin (13.11%) followed by Ife odan (12.83%), while least values
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344 were obtained for fresh cow milk sample from (Ogbomoso, Oyo and Arolu).

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346 *Minerals composition*

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348 Potassium deficiency affects the collecting tubules of the
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350 kidney, resulting in the inability to concentrate urine, and also causes alterations of gastric
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352 Secretions and intestinal motility (Soetan, *et al.*, 2010). The rapidly growing animals apparently
353
354 have a higher requirement for potassium, and increasing the protein level increases the
355
356 requirement. One of the most vital contribution of milk to human nutrition is the Calcium and
357
358 Phosphorus it supplies (Adesina, 2012). Calcium plays an important role in bones formation
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360 and metabolism, muscle contraction, nerve transmission and blood clotting. Calcium and
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362 phosphorous are required in large amount and for promotion of rapid growth of neonate. It also
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364 ensures bone growth and development of soft tissues. Phosphorous is involved in maintaining
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366 body pH, in storage and transfer of energy (Adesina, 2012). Both elements are needed for
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368 tissue and bone development while deficiency result in slow growth, depraved appetite,
369
370 unthrifty appearance and rickets (N RC, 1978). Higher value of Mg contents were observed
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372 from milk samples collected from Ogbomoso, Arolu and Oyo (0.17, 0.18 and 0.19%). The
373
374 implication of the lower Mg content from milk will lead to hyper irritability with
375
376 convulsions, loss of equilibrium And trembling tetany (Adesina, 2010). Zn is essential for
377
378 physiological processes including development, lipid metabolism, brain and immune function
379
380 and deficiency of Zn allow body to more susceptible to disease caused by viral, bacteria and
381
382 fungi infection (Adesina, 2012). Iron on the other hand is an integral part of many proteins
383
384 and enzymes that maintain good health.
385
386 It is an essential component of proteins and is involved in oxygen transport. However, excess
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388 Fe may result in poisoning even death (Chandra, 1990).
389
390 The milk sample collected from Oyo, Arolu and Ogbomoso had higher levels of Cu and
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392 the least concentration for Cu was found in the milk sample collected from Iseyin and Ifeodan.
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394 Cu is an important element in nutrition because it is an essential element for human health.

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396 However, excess in the body is undesirable. It may lead to liver and kidney damage among
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398 othereffects.
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400 Higher value of Se content were observed from milk sample collected from Oyo,
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402 Ogbomoso and Arolu (0.06, 0.05 and 0.05%). The lower values were observed for milk
403
404 Collectedfrom Iseyin and Ife odan. The selenium concentration observed in this study is lower
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406 than valuereported by Tonaet *al.*, (2013). Selenium is an essential element in nutrition. It
407
408 function as anantioxidant as well as co-factor of enzymes which protects cell membranes from
409
410 damage causedby peroxidation of lipids, thereby decreasing the risk of cancer, heart and blood
411
412 vessels disease.Selenium is a crucial nutrition for an HIV infection person (Rayman, 2000)
413
414 The milk samples collected from Iseyin and Oyo zone had highest Co and Pb. The mean values
415
416 for Pb was below the general statutory limit of 1 smg/kg set by for the lead in food regulations
417
418 (TLFR, 1979). High levels of heavy metal in Iseyin and Oyo zones may be attributed to the high
419
420 contamination of animal feed and water by pollutants and could be excreted into milk at
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422 various levels (**Abou – Arabet *al.*, 1994**) and also through poorhandling procedures.

423
424 *Bacterial count*
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426 The samples of fresh cow milk collected from Ogbomoso, Arolu and Ife-Odan had no traces of
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428 *Salmonella* and *E coli* but lower values were observed for microbial count on
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430 Ogbomoso(1.21×10^3), Arolu (1.02×10^3) and Ife-Odan (1.09×10^3). Milk collected from Oyo and
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432 Iseyin were highly contaminated with Microbial count, *Salmonella* and *E coli* respectively.
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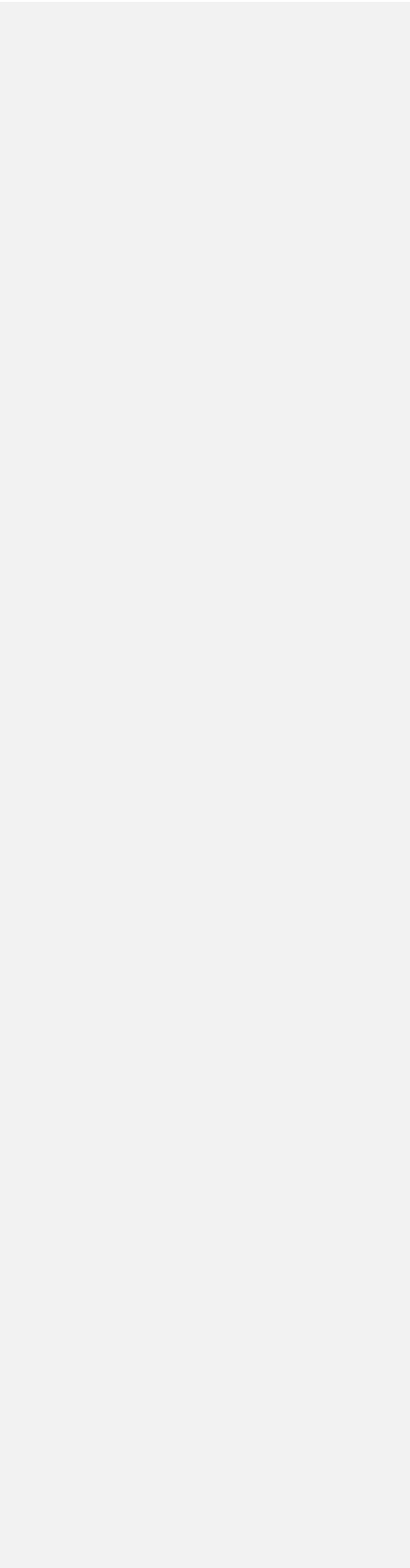
434 **Conclusion and Recommendation**

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436 This work, investigated the on- farm nutritive content and the bacteria contents of milk
437
438 from extensively managed cattle by Fulani in the derived Savanna Zone, of Nigeria. It could be
439
440 concluded that fresh cow milk collected from Ogbomoso, Arolu and Ife-Odan had higher
441
442 values of proximate and mineral contents. High sanitary practices should be encouraged before,
443
444 during and after collection of milk samples from respective animals.
445

446 Handling and processing including pasteurization, packaging and even storage of raw milk,
447
448 especially those collected or purchased directly from Fulani settlements called rugas or those
449
450 being hawked by Fulani women in town, villages and road sides is recommended to eliminate
451
452 or reduce to a tolerable level, the presence of these microbes before consumption by humans.
453
454 However, consumption of milk procured from Iseyin and Arolu areas should if possible be
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456 completely discountenanced as traces of lead in the milk make its consumption worst.

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603 **Table 1: Effects of locations on Proximate Composition of Cow Milk in Derived Savanna**

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606	PARAMETER	OGBOMOSHO	AROLU	IFE-ODAN	OYO	ISEYIN	SED
607							
608	%M	87.46	88.03	87.77	87.52	88.62	0.39
609	%CP	3.65	3.56	3.45	3.85	3.26	0.33
610	%CF	3.49	3.54	3.55	3.52	3.55	0.25
611	%TS	11.53 ^c	11.92 ^c	12.83 ^b	11.82 ^c	13.11 ^a	0.23
612	%SNF	8.88 ^b	9.70 ^a	8.43 ^b	8.95 ^b	8.30	0.35
613	%LAC	5.82	5.88	5.91	4.73	5.93	0.40
614	%ASH	0.71	0.73	0.67	0.75	0.65	0.04
615							
616							
617	Means along the same row with difference superscripts differ significant (P <0.05).						
618							
619	M- Moisture, CP- Crude protein, CF- Crude oil, TS- Total Solid Fat, SNF- Solid Non Fat, SED-						
620	Standard Error of Difference						
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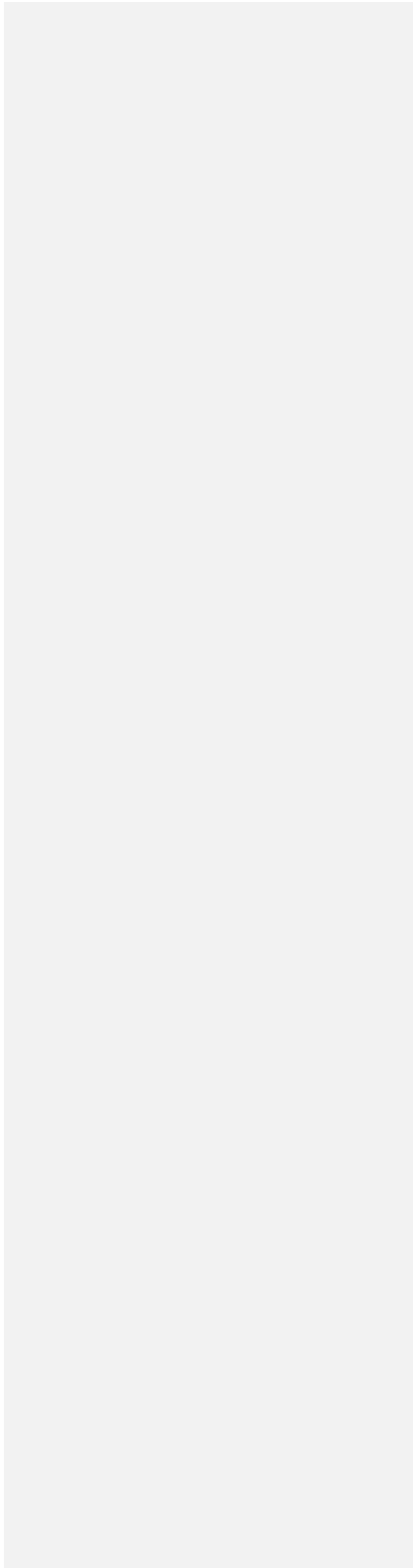


Table 2: Effect of Locations on Mineral Composition of Cow Milk in Derived Savanna

Zone.

PARAMETERS	OGBOMOSHO	AROLU	IFE-ODAN	OYO	ISEYIN	SED
%K	0.62 ^a	0.63 ^a	0.49 ^b	0.64 ^a	0.46 ^c	0.03
%Ca	0.22	0.22	0.21	0.23	0.21	0.01
%P	0.21	0.22	0.21	0.22	0.21	0.01
%Mg	0.17	0.18	0.16	0.19	0.16	0.01
%Zn	2.81 ^a	2.73 ^a	2.40 ^b	2.83 ^a	2.34 ^c	0.40
%Fe	0.55 ^a	0.56 ^a	0.37 ^b	0.56 ^a	0.32 ^c	0.02
%Cu	1.56 ^a	1.56 ^a	1.36 ^b	1.61 ^a	1.31 ^c	0.41
%Se	0.05 ^b	0.05 ^b	0.04 ^c	0.06 ^a	0.04 ^c	0.01
%Pb	0.00 ^c	0.00 ^c	0.00 ^c	0.14 ^a	0.13 ^b	0.01
%Co	0.10 ^c	0.10	0.10 ^c	0.26 ^a	0.21 ^b	0.01

Means along the same row with different superscripts differ (P<0.05).

M- Moisture, CP- Crude protein, CF- Crude oil, TS- Total Solid Fat, SNF- Solid Non Fat, SED- Standard Error of Difference

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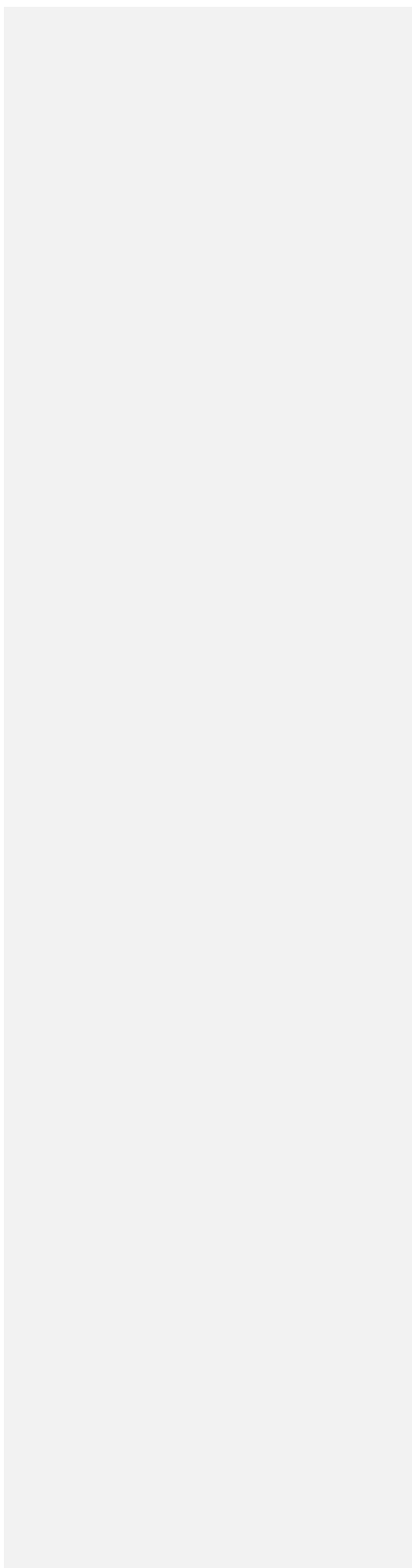


Table 3: Effects of Locations on the Bacterial Count of Milk in Derived Savanna Zone

PARAMETER	OGBOMOSO	AROLU	IFE-ODAN	OYO	ISEYIN	SED
Microbial Count	1.21x10 ³	1.02x10 ³	1.09x10 ³	9.3x10 ³	5.4x10 ²	1.29x10 ³
Salmonella	0.00	0.00	0.00	1.7x10 ³	1.9x10 ³	0.129x10
<i>E.coli</i>	0.00	0.00	0.00	2.8x10 ³	1.3x10 ³	0.19x10

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